oxynitride activated with Eu^{2+}. In the aforementioned configuration, the fluorescent material is excited by light with a wavelength range of from 360 nm to 550 nm and efficiently emits light with a wavelength longer than that of the excitation light. Hence, the light-emitting unit configured as described above has high emission efficiency. Moreover, the fluorescent material in the aforementioned configuration has a preform composed of Ca, Al, Si, O and N. Hence, it can be said that the fluorescent material can be produced from a general and inexpensive material compared with the fluorescent material (YAG) used in the background art. Hence, a light-emitting unit low in the cost of production can be provided.

Features and advantages of the invention will be evident from the following detailed description of the preferred embodiments described in conjunction with the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings:

Fig. 1 is a view showing a round-type LED unit 1 which is an embodiment of the present invention;

Fig. 2 is a schematic sectional view of a light-emitting device 10 used in the LED unit 1;

Fig. 3 is a schematic sectional view of a light-emitting

device 100 having a reflection layer just under a light-emitting layer;

Fig. 4 is a schematic sectional view of a light-emitting device 101 having a reflection layer on a surface of a substrate where no semiconductor layer is formed;

Figs. 5A and 5B are views showing rectifier circuits used in Embodiment 1;

Figs. 6A and 6B are views showing light-emitting devices 10 each having a fluorescent layer 37 with which the substrate surface is covered;

Fig. 7 is a partly enlarged view showing an example in which a planar type Zener light-emitting device 60 is used in the LED unit 1 of Embodiment 1;

Figs. 8A and 8B are views showing examples in each of which a fluorescent layer 38 is formed in the planar type Zener light-emitting device 60 so that the substrate is covered with the fluorescent layer;

Fig. 9 is a view showing a chip type LED 2 which is another embodiment of the present invention;

Fig. 10 is a view showing a chip type LED 3 similarly;

Fig. 11 is a view showing a chip type LED 4 similarly;

Fig. 12 is a view showing a chip type LED 5 similarly;

Fig. 13 is a view showing a reflection type LED 6 which is a further embodiment of the present invention;

Figs. 14A and 14B are views showing a plane light source 7 which is a further embodiment of the present invention;

Fig. 15 is a schematic configuration view of an LED unit 115 used in the plane light source 7;

Figs. 16A and 16B are views showing a plane light source 8 which is a further embodiment of the present invention;

Fig. 17 is a view showing a plane light source 9 using a color conversion filter 130 which is a further embodiment of the present invention;

Fig. 18 is a view showing a cap type LED unit 140 which is a further embodiment of the present invention;

Fig. 19 is a view showing an electric bulb type light-emitting unit 150 which is a further embodiment of the present invention;

Fig. 20 is a view showing a fluorescent lamp type light-emitting unit 160 which is a further embodiment of the present invention;

Fig. 21 is a view showing a Braun tube type light-emitting unit 170 which is a further embodiment of the present invention;

Fig. 22 is a view showing a projector type light-emitting unit 180 which is a further embodiment of the present invention;

Fig. 23 is a view showing a light-emitting lamp 190 which is a further embodiment of the present invention;

Figs. 24A and 24B are views showing a display unit 200

which is a further embodiment of the present invention;

Fig. 25 is a view showing an example of the display unit 200 different in the condition of formation of the fluorescent layer 215;

Fig. 26 is a view showing a display unit 210 using LEDs 1 which is a further embodiment of the present invention;

Fig. 27 is a view showing the circuit configuration used in the display unit 210; and

Fig. 28 is a view showing a vehicle signal unit 300 using LEDs 3 which is an embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0006]

A light-emitting device with an emission wavelength range of from 360 nm to 550 nm is used. Light with such a wavelength range can be emitted by efficiently exciting a fluorescent material which will be described later. When the light-emitting device is selected, the excitation peak and emission color of the fluorescent material and the total color of light emitted from the light-emitting unit are taken into consideration. To obtain white light emission, a light-emitting device with an emission wavelength range of from 450 nm to 550 nm is preferably used and a light-emitting device with an emission wavelength range of from 450 nm to 500 nm is